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MINERALOGY.—*Hausmannite in the Batesville district, Arkansas.*[1] H. D. MISER and J. G. FAIRCHILD, U. S. Geological Survey.

During the investigation of the manganese deposits of the Batesville district by the senior author, beginning in 1918, particular attention was given to a manganese mineral that has been previously classed as braunite. The mineral forms a large part of the marketed manganese ore and, being entirely free or almost free of chemically combined silica, differs in this respect from the typical braunite that is found in this district, as well as at practically all, if not all, other known localities. The two accompanying analyses by the junior author, taken in connection with the physical and optical properties of the mineral under discussion, indicate that it is hausmannite. Since only one other authentic occurrence[2] of hausmannite in the United States has been reported and since it is, as stated above, one of the important ore-forming minerals of the Batesville district, this paper regarding it has been prepared.

The manganese ores of the Batesville district consist of oxides, of which psilomelane, hausmannite, braunite, manganite, pyrolu-

[1] Published by permission of the Director of the United States Geological Survey.

[2] E. S. LARSEN reports an occurrence from Plumas County, Cal. The optical properties of the hausmannite from that locality are given on page 6. Dana, in listing the occurrences of hausmannite in the *System of mineralogy*, 6th Edition, says, "Also reported from Lebanon, Pa. (but very doubtful, Genth)."

site, and wad have been identified. They generally occur in rough irregular-shaped masses from less than one pound to 22 tons in weight. Most of the masses are in clay; the others are in limestone, shale, chert, and sandstone, and there is much evidence that the manganese oxides of which the masses are composed have replaced all of these inclosing materials. The oxides have been derived from manganese-bearing carbonates near the surface and have been deposited by cold waters of meteoric origin. They do not extend below the permanent water level of the district. The workable deposits occur in the nearly horizontal Fernvale limestone and Cason shale of Ordovician age and in residual clays which were mainly derived from these two formations. Most of the masses in the clays are residual, having been freed from the above-named formations by their decomposition; the others have been formed by the replacement of the clays by manganese oxides.

The hausmannite is present at a large percentage of the nearly 200 mines and prospects in the district. It occurs partly in the Fernvale limestone as a replacement material but mostly in clay as residual masses that have been set free by the decomposition of the limestone. It has not been found in deposits that have been formed by the replacement of the Cason shale and residual clays. This apparently means that there was a smaller supply of available oxygen for the formation of manganese oxides in the limestone than in the shale and clays, because hausmannite contains a smaller percentage of oxygen than the other manganese oxides that are present in the district.

Hausmannite, if chemically pure, would contain 72 per cent of manganese which is greater than that found in the other important ore-forming minerals which are psilomelane and braunite; but on account of the presence of psilomelane and other impurities perhaps no sample containing the theoretical percentage can be obtained, though the percentage of manganese in a sample from the W. T. Gray mine of which an analysis is given on page 4 is 70.76. The presence of hausmannite in the high-grade ores accounts for the fact that many carload shipments of such ore have contained between 55 and 60 per cent of

manganese. These are unusually high percentages for such shipments.

Although several oxides of manganese are present in the Batesville district, psilomelane is apparently the only one with which the hausmannite is intimately mixed. Much of the hausmannite is disseminated as large and small grains through compact psilomelane and specimens are common that show a gradation from psilomelane with a few grains of hausmannite scattered through it to a coarsely granular hausmannite with only a small quantity of psilomelane in it. Of all the specimens of hausmannite studied by the senior author both in the field and in the laboratory not one was seen that is entirely free from psilomelane.

The hausmannite is a brittle, steel-gray mineral with a chestnut-brown or reddish brown streak and submetallic luster. It is finely to coarsely granular but partly crystalline, is translucent on thin edges, has an uneven fracture, a perfect basal cleavage, and a hardness of about 5.5, and is weakly magnetic, some of the finely powdered mineral being picked up by a magnet The magnetic property might be thought to be due to the presence of iron but this can not be so because one of the samples of which analyses are given in table 1 contained no iron, and the other contained only a trace of iron. The specific gravity of the two samples that have just been mentioned was determined by the junior author to be 4.836 for one and 4.778 for the other, respectively. The crystals are small and line cavities in the massive mineral. They resemble octahedra; none have been found that could be measured. The physical properties of the mineral as given above agree with those given by Dana[3] and Fermor,[4] though these writers do not mention hausmannite as being magnetic.

The analyses in table 1 represent the composition of two samples of hausmannite from two localities, 8 miles apart. Sample No. 1 was from the W. T. Gray mine, $4^1/_2$ miles north-northwest of the village of Pfeiffer on a spur of the Missouri Pacific Rail-

[3] *System of mineralogy*, 6th Edition, 1892.

[4] L. L. Fermor. *The manganese-ore deposits of India*. Memoirs Geol. Survey India, 37: pt. 1, 229. 1909.

road, and Sample No. 2 was from the Club House mine, one-half mile north of the town of Cushman on another spur of the same railroad. The specimens from which the samples were prepared

TABLE 1

ANALYSES OF HAUSMANNITE FROM THE BATESVILLE DISTRICT

	No. 1	No. 2
Manganese protoxide (MnO)	91.38	90.40
Oxygen (O)	7.78	8.87
Iron oxide (Fe_2O_3)	None	0.48[a]
Alumina (Al_2O_3)	None	
Silica (SiO_2)	None	0.10
Lime (CaO)	Trace	Trace
Magnesia (MgO)	Trace	Trace
Baryta (BaO)	0.26	None
Total water (H_2O)	0.62	1.03
Summation	100.04	100.88
Manganese (Mn)	70.76	70.00
Specific gravity at 15.5° C.	4.836	4.778

No. 1. Sample from W. T. Gray mine.
No. 2. Sample from Club House mine.
[a] Includes a trace of iron.

for the analyses contain a small quantity of psilomelane and for this reason the samples were carefully selected, using a pocket lens, so as to free the hausmannite as far as possible from the psilomelane. Polished surfaces of these specimens, however, show the presence of psilomelane as fine, disseminated particles and as crack-filling material too minute to be observed by a pocket lens on a rough fractured surface. Some psilomelane was therefore present in the samples and the polished surfaces indicate that there was more of it in Sample No. 2 than in Sample No. 1.

There are several varieties of psilomelane, which may be considered to be a manganese manganate, Mn_2MnO_5, otherwise expressed as $2MnO_2.MnO$. In the fundamental formula, the "Mn_2" may be replaced by such equivalent groups as Ba_2, Ca_2, K_4, H_4, etc. The ratio of MnO to available oxygen, which is here called the "oxygen ratio," is, according to the above formula, 3 to 2, or expressed more simply, 1.5. The composition shows 13.1 per cent available oxygen. The oxygen ratio for hausmannite (Mn_3O_4) is 3, its composition showing 7.0 per cent avail-

able oxygen. By referring to a few published analyses of psilomelane, the average ratio for the analyses cited in table 2 is seen to approach fairly close to the above ratio (1.5).

TABLE 2

OXYGEN RATIOS OF PSILOMELANE AS SHOWN BY PUBLISHED ANALYSES

No.	Locality	Analyst	Oxygen ratio
1	Ilmenau, Germany	Clausbruch	1.18
2	Silver Cliff, Colorado	W. F. Hillebrand	1.28
3	Romanèche, France	A. Gorgeu	1.34
4	Schneeberg, Germany	Clausbruch	1.36
5	Bálághát, India	.....	1.37
6	Kájlidongri, India	.....	1.54
7	Batesville, Arkansas	Wm. Elderhorst	1.83
	Average		1.41

1. R. A. F. PENROSE, JR. *Manganese—its uses, ores and deposits.* Arkansas Geol. Survey, Ann. Rept. 1890, 1: 146. 1891.

2. F. W. CLARKE. *Data of geochemistry.* U. S. Geol. Survey Bull. 616: 534. 1916.

3. Idem, 534.

4. R. A. F. PENROSE, JR., op. cit., p. 146.

5. DANA, *System of mineralogy*, third appendix, p. 39, 1915. Sample of Hollandite.

6. Idem. Sample of Hollandite.

7. R. A. F. PENROSE, JR., op. cit., p. 147.

The analyses of the samples of the mineral in question from the Batesville district show the following calculated compositions:

	Psilomelane (Mn_2MnO_4)	Hausmannite (Mn_3O_4)	Oxygen ratio
Sample No. 1	13 per cent	87 per cent	2.65
Sample No. 2	31 per cent	69 per cent	2.30

The analyses show that silica was absent in No. 1 and that there was only 0.1 per cent of it in No. 2. These analyses have been confirmed by testing for gelatinous silica 12 other samples from 9 different localities. No silica was found in most of them and hardly more than a trace was found in the others. On the other hand, similar tests were made on 5 samples of braunite from as many different localities in the Batesville district, and they all yielded fairly large quantities of gelatinous silica. The test for gelatinous silica is, in fact, the easiest method for dis-

tinguishing hausmannite from braunite, though their streaks can be used to advantage, hausmannite having a chestnut-brown streak and braunite a dark brownish black streak.

The optical properties of a specimen of the mineral under discussion were studied by E. S. Larsen and he concluded that it is hausmannite. In fact, he expressed this opinion before the present writers arrived at their conclusion regarding the identification of the mineral and also before the two accompanying analyses (Nos. 1 and 2) were made. He has kindly furnished the following statement giving the optical properties of the specimen from the Batesville district and for comparison has given unpublished data for a specimen from Plumas County, California:

"Hausmannite from Batesville district, Arkansas; reddish brown in section and non-pleochroic. Uniaxial—; $\omega_{Li} = 2.45 \pm 0.02$; $\epsilon_{Li} = 2.15 \pm 0.02$.

"Hausmannite from Plumas County, California; reddish brown in section and non-pleochroic. Uniaxial—; tend to lie on a cleavage normal to the optic axis; $\omega_{Li} = 2.46$; $\epsilon_{Li} = 2.15$."

Penrose[5] gives an analysis of a sample of a mineral from the Batesville district whose description accords rather closely with that of hausmannite, but the composition of the sample whose analysis he gives corresponds to the formula Mn_2O_3. He therefore considered the mineral to be a silica-free braunite and this opinion has been followed by other geologists who have worked in the district, though no further analyses were made until the present investigation was undertaken. For reasons given below the writers believe that the sample for Penrose's analysis consisted mainly of hausmannite but contained admixed psilomelane. His description of the mineral and the analysis follow:

"*Braunite.*—Specimen from the Sullivan Creek fork of Polk Bayou 10 miles north of Batesville, Independence County. This is a dark iron-gray or black mineral, forming a coarsely crystalline aggregate with a marked cleavage, the crystallographic position of the cleavage being uncertain; lustre submetallic; streak dark chocolate-brown; hardness 5 to 5.5. Its specific gravity, as determined by the chemist of the Survey, is 4.50.

[5] R. A. F. Penrose, Jr., op. cit., pp. 148–149.

"With fluxes it gives manganese reactions; it dissolves in hydrochloric acid with the evolution of chlorine.

"The following analysis was made mostly by Dr. R. N. Brackett and partly by Prof. W. A. Noyes. It shows the composition of the mineral dried at 110°–115° Centigrade.

"ANALYSIS OF BRAUNITE FROM THE BATESVILLE REGION

	Per cent	Ratio	
Manganese protoxide (MnO)	87.47	1.232	2.05
Oxygen (O)	9.62	0.601	1.00
Ferric oxide (Fe_2O_3)	0.44		
Alumina (Al_2O_3)	0.11		
Lime (CaO)	0.34		
Baryta (BaO)	0.48		
Magnesia (MgO)	Trace		
Potash (K_2O)	0.10		
Soda (Na_2O)	0.05		
Phosphoric acid (P_2O_5)	0.25		
Silica (SiO_2)	0.18		
	99.04		

"It will be observed that the ratio of MnO to O is almost exactly as 2 : 1, which is the theoretical ratio of manganese sesquioxide (Mn_2O_3). It will also be noticed that the analysis shows less than 2 per cent of ingredients other than MnO and O, and the mineral is therefore a very pure Mn_2O_3. Though the mineral occurs as a compact crystalline aggregate and not as isolated crystals, it seems, judging from its general appearance and its physical characteristics, to be homogeneous. In some other specimens of a similar material there were found some very small crystals, apparently tetragonal pyramids, suggesting, from their general form, that they might be braunite. Hausmannite crystallizes in the same system, but the above analysis does not show any close relation to the composition of that mineral. The analysis shows a mineral resembling in all respects a braunite without silica, and the physical features of the specimen, as far as they can be distinguished, are also those of braunite."

Fermor,[6] in his report on the manganese-ore deposits of India, says that only two published analyses, that have not been checked by further analyses, show braunite to correspond to the formula Mn_2O_3. One of these is the above analysis given by Penrose and the other is an analysis by Bechi of a specimen from the island of Elba.[7] Fermor continues, "But it is to be noticed that another analysis of Arkansas braunite [from the Batesville district] shows 9.97 per cent of SiO_2, the analysis being by W.

[6] L. L. FERMOR. *The manganese-ore deposits of India.* Memoirs Geol. Survey India. 37: pt. 1, 64. 1909.

[7] MENEGHINI, *Mineralogical notices.* Amer. Journ. Sci. [2] 14: 62. 1852.

Elderhorst.[8] Nevertheless, it seems necessary to recognize the possible existence in nature of a mineral with a composition corresponding to the formula Mn_2O_3; it must be extremely rare."

Although a mineral with a composition corresponding to the formula Mn_2O_3 may, as pointed out by Fermor, be present in the Batesville district, its occurrence there is not believed by the writers to be probable, in view of the facts and conclusions brought out during the present investigation. Penrose, in a footnote[9] regarding the sample for his analysis, says, "The original specimen contained inclusions of a massive or semi-crystalline oxide of manganese, but the sample analyzed was carefully separated from this and was composed only of the coarsely crystalline parts." As he describes[10] psilomelane as being a massive mineral, and as psilomelane appears to be the only mineral that is intimately associated with hausmannite, the "massive or semi-crystalline oxide of manganese" in the sample for his analysis may have been psilomelane. The samples for our two accompanying analyses (Nos. 1 and 2) consisted entirely of the coarsely granular parts of the specimens so far as could be determined by means of a pocket lens, but as previously stated polished surfaces of the specimens show that it is not possible to discard all of the psilomelane by this method. A mixture containing about 60 per cent of hausmannite and 40 per cent of psilomelane (corresponding to the formula $2MnO_2.MnO$) would on analysis be found to contain manganese protoxide (MnO) and oxygen (O) in the ratio of 2 to 1, which is the ratio calculated from the analysis given by Penrose. As specimens are common showing a gradation from psilomelane with only a small amount of hausmannite in it to coarsely granular hausmannite with a very small percentage of psilomelane, a sample containing the above-mentioned percentages of these minerals could be obtained, but such a sample, it must be admitted, could be obtained only by accident.

[8] D. D. Owen. *First report of a geological reconnaissance of the northern counties of Arkansas*, 164–165. 1858; R. A. F. Penrose, Jr., op. cit., pp. 149–150.

[9] R. A. F. Penrose, Jr., op. cit., p. 148.

[10] Idem, 145.

BOTANY.—*A preliminary revision of the North American and West Indian avocados* (Persea *spp.*). S. F. BLAKE, Bureau of Plant Industry.

For several years Wilson Popenoe, of the Office of Seed and Plant Introduction, has been engaged in the collection of the various forms of the avocado, or "alligator pear," which are found in Mexico and Central America. Many new and valuable forms have been introduced into the gardens maintained by the Office, whence they are being distributed among horticulturists, and a considerable amount of herbarium material has been accumulated. This material, which has recently been put into my hands for study, is sufficient, in connection with that already in the U. S. National Herbarium, to permit a fairly satisfactory preliminary treatment of the forms of the avocado which occur in Mexico, Central America, and the West Indies. Mr. Popenoe is about to extend the field of his investigations by a two years' trip in Central and South America, in which it is hoped material will be secured to settle the status of one or two South American forms, at present too poorly represented in our herbaria to be disposed of definitely. In the meantime it is desirable to put on record the information already obtained as to the relationship of the forms north of the Isthmus.

The latest systematic treatment of *Persea americana* and its relatives is that of Mez (1889),[1] in his monograph of the American Lauraceae. Mez recognizes, in the small group made up of the avocados, two species, *Persea gratissima* Gaertn. f. (*Laurus persea* L.) and *P. floccosa* Mez. Of *P. gratissima* two varieties are recognized in addition to the type, *P. gratissima schiedeana* (Nees) Meissn. and *P. g. drymifolia* (Schlecht. & Cham.) Mez. In a later publication Mez[2] has recognized the priority of the name *Persea americana* Mill. (1768) over *P. gratissima* Gaertn. f. (1807), the name by which the common avocado has generally been known in literature.

Mr. Popenoe,[3] as a result of his extensive field acquaintance

[1] Jahrb. Bot. Gart. Berlin 5: 145–148. 1889.
[2] Arb. Bot. Gard. Breslau 1: 113. 1892.
[3] In BAILEY, *Stand. Cycl. Hort.* 5: 2556. 1916.

with the avocado, has recognized three chief forms on the basis of leaf and fruit differences. These he separates by the following key:

A. Leaves anise-scented: skin of fruit thin and soft. 1. *Mexican type.*
AA. Leaves not anise-scented: skin of fruit thick.
B. Surface of fr. usually smooth: skin leathery, usually not more than $^1/_{16}$ in. thick; seed coats frequently distinct, the outer one adhering to wall of seed cavity; cotyledons often rough.....2. *West Indian type.*
BB. Surface of fr. usually rough or warty: skin brittle, granular, $^1/_{16}$–$^3/_{16}$ in. thick; seed coats adhering closely to the nearly smooth cotyledons.....3. *Guatemalan type.*

Mr. Popenoe, moreover, has become convinced that his "Mexican type" represents a distinct species, *Persea drymifolia*, Schlecht. & Cham., and that *Persea schiedeana* Nees is a distinct species. Both of these forms were treated by Mez as varieties of *P. americana.*

In the study of the extensive material which has now been brought together it became clear at once that Mez had erred in reducing *P. schiedeana* to varietal rank, since it possesses definite specific characters, not only in the pubescence of its leaves and its long pedicels, but also in the technical features of its floral parts, which were entirely passed over by Mez. *P. drymifolia* is a more doubtful form, not always distinguishable with certainty in herbarium material, and I prefer, at least for the present, to treat it as a variety of *P. americana.* The novel fact appears, moreover, that the most commonly cultivated avocado of Florida, known as the Trapp, represents a technically very distinct and undescribed species, characterized by its sparsely pubescent perianth and absolutely glabrous pistil and staminodes. Another new species of the avocado group, characterized by its glabrous ovary, narrow panicle, and sessile staminal glands, has been collected by Purpus in Oaxaca and is here described as *P. cinerascens.*

While the relationships of the North American forms can be considered as now established with a fair degree of definiteness, this cannot be said of the South American types. In addition to typical *P. americana* and its variety *drymifolia*, at least two

other forms occur in South America which, through lack of sufficient material, cannot be definitely placed. One is the plant described as *P. gratissima* var. *melanocarpa* by Philippi,[4] a single specimen of which is in the National Herbarium. It is peculiar in its comparatively large bracts and subsimple panicles shorter than the peduncles. The other, collected by Mr. Pittier near Caracas (no. 5913), has a glabrous ovary, pubescent style, and unusually long stipes to the glands of the third series of stamens. Both these forms are best left in abeyance until further material becomes available.

The avocados[5] occurring in North America and the West Indies may be distinguished by the following key:

Perianth densely griseous-puberulous on both sides; staminodes pubescent.
Ovary pubescent; staminal glands stipitate.
Pedicels 1 to 6 mm. long; staminode with triangular head, much broader than its stipe.
Branchlets glabrous to pilosulous, leaves glabrous to pilosulous beneath; filaments 2 to 3 times as long as the anthers; head of staminode much shorter than the stipe.
Leaves not anise-scented; perianth deciduous. 1. *P. americana.*
Leaves anise-(or sassafras-)scented; perianth usually persistent. 1a. *P. americana drymifolia.*
Branchlets fulvous-villous; leaves floccose-tomentose beneath; filaments only one-third longer than the anthers; head of staminode about equaling or exceeding the stipe. 2. *P. floccosa.*
Pedicels 8 to 15 mm. long; stipe of staminode twice to thrice as long and essentially as broad as the elliptic head; branchlets densely ferruginous-tomentose. 3. *P. schiedeana.*
Ovary glabrous; staminal glands sessile. 4. *P. cinerascens.*
Perianth sparsely pilosulous outside, essentially glabrous within; pistil and staminodes glabrous. 5. *P. leiogyna.*

[4] Anal. Univ. Chil. 91: 501. 1895.

[5] The avocados form a small group of the subgenus *Eupersea* Mez, characterized by their comparatively large flowers (usually 6 to 8 mm. long) with equal or only slightly unequal perianth segments. Of the species here considered, the most important commercially are *P. americana*, *P. americana drymifolia*, and *P. leiogyna*. *P. schiedeana* also has a large and well-flavored fruit, but is of little importance at present outside of its native habitat. *P. cinerascens*, and presumably *P. floccosa*, bear fruits too small to be of any value.

1. **Persea americana** Mill. Gard. Dict. ed. VIII. 1768. COMMON AVOCADO.

Laurus persea L. Sp. Pl. **1**: 370. 1753.
Persea gratissima Gaertn. f. Fruct. **3**: 222. pl. 221. 1807.
Persea gratissima vulgaris Meissn.; DC. Prodr. **15**[1]: 53. 1864.
Persea gratissima oblonga Meissn.; DC. Prodr. **15**[1]: 53. 1864.
Persea gratissima macrophylla Meissn.; DC. Prodr. **15**[1]: 53. 1864.
Persea persea Cockerell, Bull. Torrey Club **19**: 95. 1892.

Tree, up to 20 meters high; branchlets glabrous to finely puberulous or pilosulous, more or less glaucous; leaf blades 9 to 30 cm. long, 3.5 to 20 cm. wide, oval varying to elliptic or obovate-oval, rarely ovate or suborbicular, short-pointed, acute, or acuminate, sometimes obtuse, at base unequal, broadly rounded to cuneate, papyraceous to pergamentaceous, feather-veined (lateral veins 5 to 7 pairs) and finely prominulous-reticulate beneath, above deep green, glabrous or sparsely pubescent along costa, beneath glaucescent, glabrous or pilosulous with more or less spreading hairs along costa and primary veins, rarely over whole surface; petioles glabrous or puberulous, 2 to 6.5 cm. long; panicles densely griseous-puberulous, several or many toward ends of branches, 6 to 22 cm. long (including the 2.5 to 9 cm. long peduncle); pedicels 3 to 6 mm. long; perianth (5) 5.5 to 7 mm. long, densely griseous-tomentulose both sides; segments elliptic or lance-elliptic to oval-ovate, obtuse, the outer 1 to 1.5 mm. shorter than the inner; stamens of series I 4.5 to 5.5 mm. long, the slender filaments densely pilose, 3 to 3.8 mm. long; of series II similar, 4 mm. long; of series III similar, 4.5 to 5.4 mm. long, the filaments (3.2 to 4 mm. long) bearing 0.5 to 0.8 mm. above base two rotund obtuse or rounded glands on pilose stipes of about the same length; staminodes 1.8 to 2.8 mm. long, the densely pilose stipe 1 to 1.8 mm. long, the head triangular, acute, usually apiculate, truncate or sagittate-cordate at base, 0.3 to 1.2 mm. long; ovary densely pilose, style pilose, about twice as long as ovary.

TYPE LOCALITY: West Indies.

SPECIMENS EXAMINED:

VERA CRUZ: San Pablo near Rio Nautla, June, 1841, *Liebmann* 13. Colipa, March, 1841, *Liebmann* 86. Orizaba, June, 1918, *Popenoe* 826 (S. P. I.).

PUEBLA: Atlixco, Dec., 1918, *Popenoe* 864 (S. P. I.).

OAXACA: Cafetal Concordia, near Pochutla, May, 1919, *Popenoe* 825 (S. P. I.).

CHIAPAS: Tapachula, Nov., 1918, *Popenoe* 819, 821 (S. P. I.). Zacualpa, July, 1918, *Popenoe* 828 (S. P. I.).

YUCATAN: Izamal, 1895, *Gaumer*, 402.

GUATEMALA: Near Finca Sepacuité, Alta Verapaz, 1902, *Cook & Griggs* 20, 322, 564. Guatemala City, Feb., 1917, *Popenoe* 758 (S. P. I.). Antigua or vicinity, Feb., 1917, *Popenoe* 765, 766, 767, 769, 771 (S. P. I.). Los Verdes, Dept. Amatitlan, Nov., 1893, *Heyde & Lux* 6229. Pacaya, March, 1890, *J. D. Smith* 1941.

EL SALVADOR: Without definite locality, 1905, *Renson* 219.

COSTA RICA: San Francisco, March, 1897, *Tonduz* 10999. Port

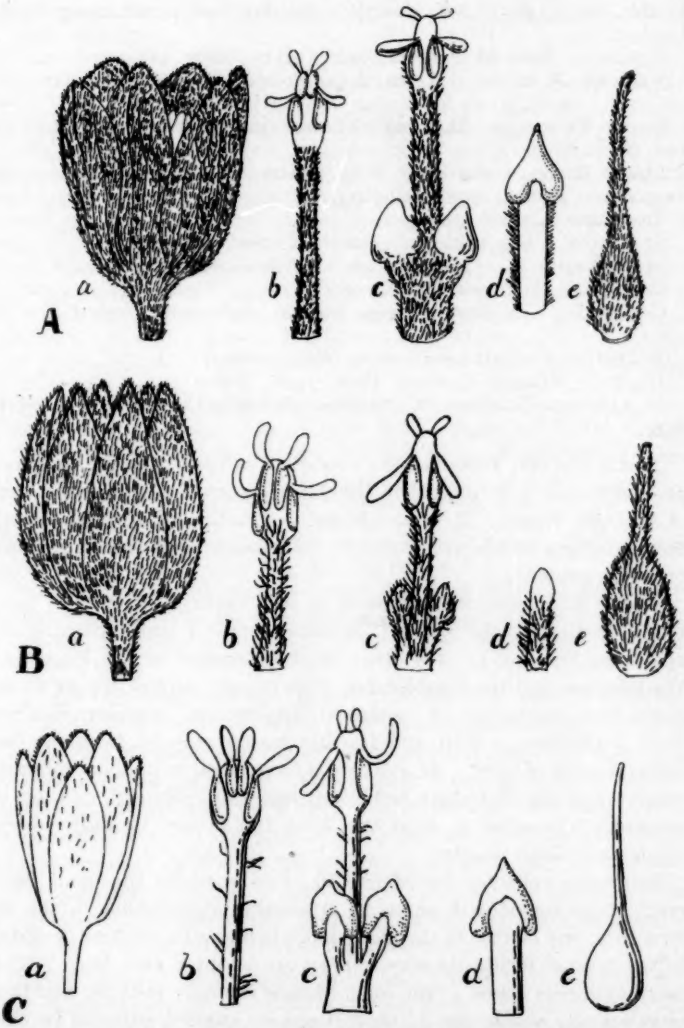

Fig. 1.—A, *Persea americana* Mill. B, *P. schiedeana* Nees (drawn from Purpus 7074). C, *P. leiogyna* Blake (drawn from Popenoe 219). *a*, perianth, × 5; *b*, stamen of series I, × 10; *c*, stamen of series III, viewed from dorsal side, × 10; *d*, staminode, × 10; *e*, ovary, × 10.

Limon, May, 1903, *Cook & Doyle* 476. San José, April, 1903, *Cook & Doyle* 2.

PANAMA: Around Culebra, Jan., 1911, *Pittier* 2144.

BAHAMA ISLANDS: Nassau, New Providence, 1903, *Curtiss* 116.

CUBA: Santiago de las Vegas, 1905, *Abasco* 4556.

SANTO DOMINGO: Without definite locality, 1871, *Wright, Parry, and Brummel.*

PORTO RICO: Cabo-Rojo, 1885, *Sintenis* 759, 759*b*. Ponce, 1903, *Prey* 69. Caguas, 1899, *Heller* 931.

ST. THOMAS: 1881, *Eggers.*

ST. CROIX: Big Princess, 1896, *Ricksecker* 305.

MARTINIQUE: 1871, *Hahn* 350. Without date, *Duss* 1948.

GRENADA: Belmont, St. Georges, 1905, *Broadway.*

COLOMBIA: Vicinity of Santa Marta, 1898–1901, *Herbert H. Smith* 1760.

BOLIVIA: Cochabamba, 1891, *Bang* 1162.

BRAZIL: Botanic Garden, Pará, 1908, *Baker* 59.

PHILIPPINE ISLANDS: Cultivated, Manila, Luzon, **1919, *Merrill*** 6347.

This is the first known of the avocados, and is by far the commonest and most widely cultivated in the American tropics and in the tropics of the Old World. It is undoubtedly a native of tropical America, but specimens which were certainly indigenous where found are nearly or quite unknown.

Of the three races distinguished by Mr. Popenoe, whose key has already been cited, the first or "Mexican type" is here separated as *P. americana drymifolia*. The other two races, called by Mr. Popenoe the West Indian and the Guatemalan, respectively, do not appear to show distinctive characters of botanical importance, however significant their differences in fruit and fruiting season may be from the horticultural point of view. At any rate, I have failed to find any differences whatever in the abundant herbarium material examined, and am consequently compelled to treat the West Indian and Central American forms as a single species.

Specimens collected by Merrill in Manila, where the plant has recently been introduced, show an interesting abnormality in the floral structure, one or two of the staminodes being antheriferous in addition to the normal fertile stamens. They are about 4 mm. long, with the hairy filaments about 3 mm. long, bearing laterally near the middle one or two sessile adnate glands; the anthers are 4-celled, with the two lower cells laterally dehiscent, the upper cells introrse. This occasional conversion of the staminodes into stamens was long ago noted by Meissner.[6]

[6] DC. Prodr. 15[1]: 53. 1864.

1a. **Persea americana drymifolia** (Schlecht. & Cham.) Blake. MEXICAN AVOCADO.

Persea drymifolia Schlecht. & Cham. Linnaea 6: 365. 1831.

Persea gratissima drymifolia Mez, Jahrb. Bot. Gart. Berlin 5: 147. 1889.

Leaves anise- or sassafras-scented when crushed, usually smaller than in *P. americana*, elliptic, and acute or acuminate at each end, but sometimes as broadly oval as in *P. americana*, and showing the same variation in pubescence; perianth equaling that of the larger-flowered examples of *P. americana*, its segments usually persistent in young fruit or even to maturity; fruit thin-skinned.

TYPE LOCALITY: Papantla, Vera Cruz, Mexico.

SPECIMENS EXAMINED:

NUEVO LEON: Monterey, March, 1891, *Dodge* 150.

SINALOA: Above Colomas, July, 1897, *Rose* 1813.

SAN LUIS POTOSI: Without definite locality, 1879, *Schaffner* (Vigener No. 572).

TEPIC: Between Aguacate and Dolores, 1897, *Rose* 2013.

VERA CRUZ: Fortin, 1883, *Kerber* 306. Patio of Hotel Colon, Puerto Mexico, July, 1918, *Popenoe* 827 (S. P. I.). San Andres Tuxtla, 1918, *Popenoe* 824 (S. P. I.).

STATE OF MEXICO: Coyoacan, Federal District, Jan., 1919, *Popenoe* 854, 855, 856 (S. P. I.).

PUEBLA: Cultivated, Orizaba, 1857, *Mohr*. Atlixco, Dec., 1918, *Popenoe* 857, 859, 860, 861, 862, 863 (S. P. I.).

GUATEMALA: Roadside below Santa Maria de Jesus, Zacatepequez, Oct., 1916, *Popenoe* 675 (S. P. I.), Feb. 1917, *Popenoe* 770 (S. P. I.).

ECUADOR: Quito, 1918, *Rose & Rose* 23556. Cultivated, Ambato, 1918, *Rose & Rose* 22338.

This, the common Mexican race of avocado, is a form of doubtful rank. In its commonly persistent or subpersistent perianth it departs not only from its close relative *P. americana* but from the character ordinarily given for the genus. This feature is not universal, however, and the form in the absence of fruit can be distinguished only by its anise-scented leaves. I can find no differences whatever in floral structure, and therefore rank it for the present as a variety of *P. americana*. Mr. Popenoe, however, who is familiar with the plant in the field, is of the opinion that it represents a distinct species. Its Mexican name is given in the original description as "aguacate oloroso."

2. **Persea floccosa** Mez, Jahrb. Bot. Gart. Berlin 5: 148. 1889.

Tree with fulvous-villous, glabrate branchlets; leaf blades 11 to 17 cm. long, 4.8 to 7.5 cm. wide, ovate, acuminate, at base obtuse or somewhat acutish, densely ferruginous-lanate on both sides when young, in age above subglabrate, densely foveolate-punctate, beneath glaucescent, floccose-tomentose, loosely prominent-reticulate; petioles up

to 4.5 cm. long; panicles pyramidate, shorter than the leaves, ochraceo-villous; pedicels 1 to 3 mm. long; perianth villous, 5 mm. long, the segments equal, narrowly ovate, acute; filaments $^1/_3$ longer than the anthers, densely long-pilose, those of series III bearing at base two large sub-globose acute glands; staminodes foliaceous-triangular, not barbellate at apex, the head slightly longer than the densely long-pilose stipe; ovary densely pilose, ellipsoid, about equal to style; fruit unknown.

TYPE LOCALITY: Chinantla, Puebla, Mexico.

This species, based on *Liebmann* 85, does not seem to have been collected again. It is said to bear the name "aguacate cimaron." No material has been seen by the writer, and the above description is translated from Mez's original.

3. **Persea schiedeana** Nees, Syst. Laur. 130. 1836. COYÓ.

Persea gratissima schiedeana Meissn.; DC. Prodr. **15**[1]: 53. 1864.

Persea pittieri Mez, Bot. Jahrb. **30**: Beibl. **67**: 15. 1901.

Tree 15 to 20 meters high, rarely to 50 meters; branchlets stout, densely ferruginous-tomentose, glabrescent; leaf blades 12.5 to 30 cm. long, 7 to 15 cm. wide, obovate or elliptic-obovate to oval-obovate or sometimes oval, at apex abruptly short-pointed, obtuse, broadly rounded, or even subtruncate, at base broadly rounded, cuneate-rounded, or subcordate, feather-veined (lateral veins 11 to 13 pairs) and rather loosely prominulous-reticulate beneath, above deep green, in youth densely ferruginous-tomentose, in age glabrate or merely tomentose along costa and sometimes along chief veins, beneath glaucous, along veins and veinlets or over whole surface densely pilosulous with loose spreading sordid-griseous hairs; petioles stout, densely sordid or ferruginous-tomentose, at length glabrescent, 1.5 to 4.5 cm. long; panicles densely griseous-tomentulose, nearly equaling the unfolding leaves, 10 to 12 cm. long (including the 4.5 to 6.5 cm. long peduncle); pedicels 8 to 15 mm. long; perianth 6 to 8 mm. long, densely griseous-tomentulose both sides; tube obsolete; segments subequal, lance-elliptic, gradually narrowed to an acutish tip, 2.5 to 2.8 mm. wide; stamens of series I 3.2 to 3.5 mm. long, the rather slender densely pilose filaments 2 to 2.2 mm. long, the anther 1.3 mm. long; of series II similar, 4 mm. long, those of series III similar, 3.6 mm. long, the densely pilose filaments bearing essentially at the base two ovate obtuse pilose glands on pilose stipes of about the same length to twice as long; staminodes 1.3 to 1.9 mm. long, pilose, the stipes subulate, twice to thrice as long and essentially as broad as the elliptic obtuse head; ovary densely pilose, twice as large as in *P. americana;* style pilose, two-thirds as long as the ovary.

TYPE LOCALITY: Misantla, Vera Cruz, Mexico.

SPECIMENS EXAMINED:

MEXICO: Zacuapan, Vera Cruz, March, 1914, *Purpus* 7074. Tree in forest, probably indigenous, Dos Ríos, near Santa Lucrecia, Vera

Cruz, April, 1918, *Popenoe* 830 (S. P. I.). Cultivated, San Anrdes Tuxtla, Vera Cruz, April, 1918, *Popenoe* 829 (S. P. I.).

GUATEMALA: San Augustín, Nov., 1916, *Popenoe* 741 (S. P. I.). Near Finca Sepacuité, Alta Verapaz, March, 1902, *Cook & Griggs* 21. Sepacuité, May, 1914, *Cook & Doyle* 43. Near Finca Sepacuité, Nov., 1916, *Popenoe* 745 (S. P. I.). Common wild and cultivated, Tactic, Alta Verapaz, March, 1917, *Popenoe* 772, 775 (S. P. I.). Rare, north bank of Motagua, above El Rancho, Nov., 1916, *Popenoe* 739 (S. P. I.).

COSTA RICA: Without definite locality, 1905, *Wercklé*.

PANAMA: Foot of El Salto Ravine, El Boquete, Chiriqui, altitude 1000 to 1300 meters, March, 1911, *Pittier* 3132.

This species, incorrectly treated as a variety of *P. americana* (*P. gratissima*) by Mez, is readily distinguished by its densely ferruginous-tomentose branchlets, long pedicels, equal perianth-segments, narrow staminode tips, and short style.

Mr. Popenoe, in the manuscript notes which he has courteously placed at my disposal, has noted the following names for this species: coyó and coyocté (at Senahu, Sepacuité, Guatemala), kiyó (San Cristóbal, Cobán), kiyaù (Cobán), chucte (El Rancho), chaucte (San Augustín), shucte (Zacapa), kotyó (Chamá, Alta Verapaz). In Mexico it is known as chinini. Mr. Pittier describes the tree from which he collected specimens (no. 3132) as about 50 meters high, 1.2 m. in diameter at base, with brownish yellow flowers. The fruits were said to be about 10 cm. in diameter, with a thick mesocarp, and of exquisite flavor. The vernacular name is given as aguacatón.

According to Mr. Popenoe, the flowers are produced from November to March in Guatemala, and the fruit ripens from July to October. The flowers are pale greenish yellow, turning crimson at base in age, or sometimes light rose, the stamens likewise turning crimson with age. The staminal glands are bright orange. The flowers of *P. americana* are described by Mr. Popenoe as pale green, not changing color in age.

The fruit of the coyó (*P. schiedeana*) is said by Mr. Popenoe to be much like that of the common avocado, and equally variable in appearance and quality. The skin is thick but leathery and pliable, and the flesh of a brownish white color and a fine oily texture, almost always penetrated by fibres. The flavor is much like that of the common avocado, but distinguishable, suggesting that of a ripe coconut. The cotyledons when cut are rose-pink in color, while they are whitish in the avocado.

Although the type number of *Persea pittieri* Mez (*Pittier* 1156,

from Valle de Rancho Redondo, near Volcán Irazù, altitude 1500 meters, Costa Rica) has not been available for examination, it is clear from Mez's full description that his plant is only *P. schiedeana*. His error is undoubtedly due to the fact that he had previously treated *P. schiedeana* as only a variety of *P. gratissima*, and consequently did not consider it in this connection.

4. Persea cinerascens Blake, sp. nov.

Tree; branchlets of the year densely pilose-tomentose with sordid-rufescent hairs; older branchlets fuscous, more sparingly pilose-tomentose; leaves alternate, crowded on the young branchlets, the blades 10 to 20 cm. long, 5 to 8 cm. wide, elliptic to oval-oblong or obovate, acute

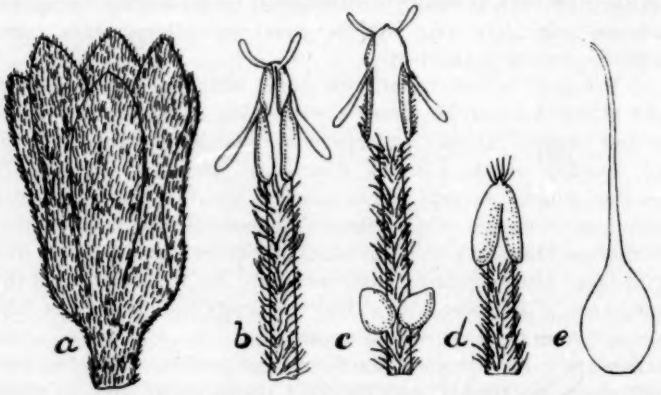

Fig. 2.—*Persea cinerascens* Blake (drawn from Purpus 7671). *a*, perianth, × 5; *b*, stamen of series I, × 10; *c*, stamen of series III, viewed from dorsal side, × 10; *d*, staminode, viewed from ventral side, × 10; *e*, ovary, × 10.

or short-pointed but blunt at apex, cuneate at base, chartaceous, entire, above dull green, rather obscurely foveolate, with impressed veins, sordidly pilose-tomentose chiefly on costa and lateral veins, beneath cinerascent, sordidly pilosulous on whole surface but more densely so on the veins with crisped spreading hairs, prominent-reticulate, the 14 to 16 pairs of lateral veins diverging at an angle of 45° to 60°, the secondaries connecting them nearly at right angles; petioles pilose-tomentose with sordid-rufescent hairs, 2 to 3 cm. long; peduncles axillary, 3.5 to 7 cm. long, like the whole inflorescence sordidly pilose-tomentose; panicles 5 to 7 cm. long, 3 to 4 cm. wide, narrowly subpyramidate, the short branches 3- to 6-flowered toward apex; bractlets deciduous; pedicels stout, 1 mm. long; perianth 7 to 8.5 mm. long, densely pilosulous-tomentose both sides with sordid-cinereous hairs, the tube about 1 mm. long, the segments elliptic-oblong, 1.8 to 2 mm.

wide, obtusish, the outer 1 to 1.5 mm. shorter than the inner; stamens of series I 4.8 mm. long, the densely pilose filaments 3 mm. long, the slightly broader anthers 1.8 mm. long; stamens of series II similar, 4.5 mm. long; stamens of series III 5.2 mm. long, the densely pilose filament 3.4 mm. long, bearing 0.7 mm. above base two sessile ovoid pilosulous glands 0.7 mm. long, the anther 1.8 mm. long, the lower cells subextrorsely dehiscent, the upper lateral-introrse; staminodes 3 mm. long, the densely pilose filament 1.7 mm. long, the cordate-sagittate apiculate gland 1.3 mm. long, glabrous on inner face, dorsally pilose and barbate at apex; ovary ellipsoid, glabrous, 1.5 mm. long; style slender, glabrous, 3.5 mm. long; extreme base of calyx segments thickened and persistent in fruit, forming a saucer 1 mm. high, 4.5 mm. wide; berry subglobose, glaucous-blue, about 12 mm. long and thick; seed globular, 8 mm. thick.

Type in the U. S. National Herbarium, No. 884613, collected at Zacuapan, Vera Cruz, Mexico, June, 1916, by C. A. Purpus (No. 7671). Duplicates in the Gray Herbarium. Also collected in fruit at the same locality at a later date by Purpus (No. 8144).

This species is readily distinguished by its glabrous ovary, sessile staminal glands, narrow panicle, and by the pubescence of its leaves. In Mez's treatment of *Persea* it seems to come nearest to *P. liebmanni* Mez, from the description of which it differs in its larger flowers, longer anthers, staminodal glands glabrous inside, and larger berry. It is evidently of no importance as a food plant.

The sheet in the National Herbarium is in bud only, and the complete description of the species has been made possible through the kindness of the Gray Herbarium in loaning two sheets of the same number bearing a few opened flowers, and of Mr. T. S. Brandegee in sending fruiting material of a later collection by Purpus from the same locality.

5. **Persea leiogyna** Blake, sp. nov. TRAPP AVOCADO.

Tree about 10 meters high, with broad low head; branchlets stout, glabrous, glaucous; leaves alternate, the blades 7.5 to 16 cm. long, 4.5 to 8 cm. wide, ovate or elliptic-ovate to oval, acute or short-pointed, the apex usually blunt, at base unequal, rounded to cuneate-rounded, pergamentaceous, pinnate-veined (veins 4 to 9 pairs, prominulous-reticulate beneath), above deep green, glabrous, beneath somewhat glaucous, glabrous or with very sparse short incurved hairs along costa and toward base of primary veins; petioles glabrous, 2 to 3.5 cm. long; panicles axillary, 5.5 to 10 cm. long (including peduncle, this 2 to 4 cm. long), crowded toward tips of branchlets, about twice as long as the petioles, rather sparsely puberulous with loose curved hairs, not at all canescent; pedicels 2 to 4 mm. long; perianth yellowish green, 5.3 to 6 mm. long, short-ciliate above middle and sparsely pilosulous outside with loosely spreading curved hairs, essentially glabrous inside, punctate, the segments elliptic-oblong, obtuse to rounded, the outer

4 to 5 mm. long, 2 mm. wide, the inner slightly longer, 5.3 to 6 mm. long, 2 mm. wide; stamens of series I 3 to 4 mm. long, with slender sparsely ciliate filaments 1.5 to 2.7 mm. long; of series II similar but longer, the filaments 2.2 to 2.9 mm. long, the anther 1.3 mm. long; of series III similar, the filaments 2.5 to 3.2 mm. long, the anthers 1.2 to 1.4 mm. long, the glands borne about one-sixth to one-fifth the length of the filament above its base, ovate or rotund-ovate, obtuse or obliquely emarginate at apex, cordate-sagittate at base, glabrous, borne on distinct but shorter glabrous stipes; staminodes glabrous, 1.8 to 2.5 mm. long, the head triangular, narrowed from the base, apiculate, equaling or shorter than the filament; ovary glabrous, ovoid; style glabrous, slightly longer than ovary; fruit oblate to globose, 7 to 12 cm. long, light yellowish green outside, with smooth thickish skin; seed often loose in the cavity.

Type in the U. S. National Herbarium, No. 1012124, collected in Charles Deering's grove at Buena Vista, Florida, April 7, 1916, by Wilson Popenoe (No. 219). Other specimens examined (cultivated): FLORIDA: Plant Introduction Garden, Miami, April 5, 1916, *Popenoe* 196, 198 (S. P. I.).

In foliage characters *Persea leiogyna* is so close to many specimens of *P. americana* that the two species can not be distinguished by leaves alone. In its shorter greenish yellow (when dried) sparsely pilosulous perianth, its smaller sparsely ciliate stamens, its glabrous staminodia, and its glabrous ovary, however, *P. leiogyna* is unique in the group of species known under the name of avocado.

Persea leiogyna is the commonly cultivated "Trapp avocado" of Florida, from Fort Pierce to Winter Haven, Bradentown, and southward. The "Family avocado," represented by *Popenoe* 196, is identical in botanical characters. The latter is said to be a variety of local origin, rather extensively propagated.

The material of this species which I have examined consists of that above cited, and in addition eight branches from different trees of the "Trapp avocado" collected in the vicinity of Miami in the early spring of 1919 by Mr. Popenoe. All of these agree precisely with the type in the diagnostic characters above mentioned. The species flowers from March to April, and fruits from October to December.

The many thousand trees of the Trapp avocado now in cultivation in Florida and Cuba have all been produced by budding and grafting from the single original tree, grown in Florida from seed believed to have been brought from Cuba, by the late C. L. Trapp, of Cocoanut

Grove, Florida.[7] As might be expected from the method of propagation, they have remained very constant in their characteristics, and specimens from different trees throw no light on the possible origin of the species. It is of the so-called West Indian race, with smooth, leathery, thick-skinned fruit and seed commonly loose in the cavity. Whether it really is a long-distinct wild species, a native of Cuba or more probably brought there from other regions, whose wild original is extinct or awaits rediscovery, or whether it is a comparatively recent mutant under cultivation, or perhaps even a hybrid, are questions which at present can receive no answer. It is possible that the seedlings now being grown in South Florida may throw light on the question when they flower. On the basis of our present information, however, and in view of its striking and constant technical characters, the species must be considered one of the most distinct in the genus.

[7] The name "Trapp avocado" was given by Prof. R. H. Rolfs (Bur. Pl. Indus. Bull. 97: 119. 1907) in honor of "Mrs. Trapp, Cocoanut Grove, Fla., who owns the original tree."

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. The abstracts should conform in length and general style to those appearing in this issue.

PHYSICS.—*Reflecting power of stellite and lacquered silver.* W. W. COBLENTZ and H. KAHLER. Bur. Standards Sci. Paper **342.** Pp. 3. 1919.

It is shown that the reflectivity of stellite varies somewhat in the visible spectrum, depending upon the homogeneity and no doubt upon the exact composition of the alloy.

Data are given on the reflecting power of lacquered silver mirrors, before and after exposure to ultra-violet light. It is shown that owing to photochemical action in the lacquer, the silver is turned brown in color, thus reducing its reflecting power. W. W. C.

CHEMISTRY.—*Bibliography of scientific literature regarding helium.* Bur. Standards Circular **81.** Pp. 21. 1919.

The year 1918 marks the beginning of a new era in the history and use of helium. Before that time only a few liters of the gas had been collected and the cost per liter was enormous. During the war the development of great fractionating plants capable of separating from natural gas a sufficient quantity of helium to supply a fleet of airships has aroused the keen interest not only of engineers and scientists, but also of the general public, in the unique properties of this gas. This circular contains a bibliography of the scientific literature relating to helium prepared for use during the war and now published. Related papers are grouped together in their chronological order, making the bibliography, in effect, a brief outline history of the subject.

E. R. W.

ENTOMOLOGY.—*The ants of Cocos Island.* WILLIAM MORTON WHEELER. Proc. Calif. Acad. Sci. [4] **2:** Pt. 2, 299–308. June, 1919.

In this, the second publication dealing with the ants of Cocos Island, the author records seven forms of ants from the island. Two of these are considered really endemic and characteristic. "It is evident that

the Cocos ants are decidedly tropical whereas those of the Galapagos are mainly such as belong to subtropical or temperate regions or at any rate to the cooler or subalpine regions in the New World tropics. * * * * The data derived from a study of the ants are too meager to enable me either to accept or to reject Stewart's view that Cocos is a true oceanic island of more recent origin than the Galapagos and that it has received its biota as 'Flotsam and jetsam' from the Central American mainland." S. A. ROHWER.

ENTOMOLOGY.—*The ants of the Galapagos Islands.* WILLIAM MORTON WHEELER. Proc. Calif. Acad. Sci. [4] **2**: Pt. 2, 259–297. June, 1919.

In the introduction the author gives a history of the development of our knowledge of the ants of the Galapagos Islands and briefly reviews the literature of the two opposing theories of the development of the islands. In reference to these theories he states that "The unbiased worker can only conclude from what has been written on the subject, and notwithstanding the many excellent monographs that have been produced on various portions of the fauna and flora, that we need a still more intensive and exhaustive exploration of the islands and above all a much better acquaintance with their geology than we now possess, before he can definitely accept either of the hypotheses."

The number of ants recorded from the islands comprise 36 different forms representing 18 species, 10 genera and four of the five subfamilies of the Formicidae. Only nine species are considered as clearly indigenous to the islands and all of these are distinctly Neotropical in their affinities but all but three or four are either well-known species widely distributed in tropical and subtropical portions of America or are merely subspecies or varieties of such forms. The author considers that no fewer than 26, or 72.2 per cent, of the 36 forms (subspecies and varieties) are endemic. S. A. ROHWER.

VOLCANOLOGY.—*The composition of the gases of Kilauea.* E. S. SHEPHERD. Bull. Hawaiian Volcano Obs. **7**: 94–97. July, 1919.

Since 1912, when Day and Shepherd collected the first gas samples ever taken from the Kilauea crater, work has continued on the composition of these gases. Further collection was made in 1917 and a shipment of gases collected by Dr. T. A. Jaggar, Jr., director of the observatory at Kilauea, has just been received. This work presents

rather unusual difficulties in the matter of collection and also in the analysis.

This preliminary report is concerned primarily with the 1917 collection, but includes a new analysis of one of the 1912 tubes and one tube from Jaggar's 1918–19 collection, for comparison. From an examination of the tables of analyses it appears that the gases from this volcano vary greatly in composition. About the only constituent which appears in more or less constant quantity is water vapor, which averages about 50 per cent of the gases given off by the lava. This refers, of course, to the gases obtained from the inside of flames, *i. e.*, before the gas has come in direct contact with air. The remaining constituents are CO_2, CO, H_2, N_2, Ar (trace), SO_2, and S_2, with traces of Cl_2 and F_2. The chief ingredients are CO_2, SO_2, S_2, and H_2O. It seems significant that the combustible gases are (at the surface) relatively small in amount, and this doubtless explains the quiet nature of Kilauea eruptions—there is little left to furnish an explosion. It is also probable that with the additional evidence which the gases recently collected by Jaggar and the systematic collection which he purposes for the future will furnish, we shall be able to establish the relative importance of the several hypotheses thus far proposed to account for the energy supply of this crater. The analyses of the 1917 gases are as follows:

GASES COLLECTED FROM KILAUEA, 1917

[Volume per cents at 1200°C.]

Tube	CO_2	CO	H_2	N_2	Ar	SO_2	S_2	Cl_2	H_2O
1[1]....	2.65	1.04	4.22	23.22	udt.	0.16	0.70	udt.	67.99
2[1]....	17.95	0.36	1.35	37.84	udt.	3.51	0.49	udt.	38.48
3.....	33.48	1.42	1.56	12.88	0.45	29.83	1.79	0.17	17.97
4.....	11.12	3.92	1.42	.....	0.51	.....	8.61	0.02	77.50
5.....	9.54	1.12	1.53	10.47	.....	9.90	2.72	.....	64.71
6.....	1.97	0.82	0.21	3.50	0.07	0.95	2.70	.....	89.77
7.....	17.25	0.62	0.76	5.88	0.18	9.75	1.07	0.25	64.18
8.....	15.27	0.45	0.70	0.87	0.14	6.98	0.49	.....	75.08
9.....	8.32	0.82	1.82	8.92	0.29	16.80	2.49	1.01	59.97
10.....	1.54	0.43	0.37	2.44	0.39	.....	3.56	1.34	89.93

[1] Tubes 1 and 2 were analyzed before the calcium tube was added to the apparatus, so that the rare gases were not determined. Chlorine was not determined in these tubes (udt.). Other blanks in the table mean that the gas was not present in determinable amounts.

E. S. S.

CHEMICAL TECHNOLOGY.—*The technique of optical glass melting.* CLARENCE N. FENNER. Journ. Amer. Ceram. Soc. **2**: 102–145. February, 1919. (Geophysical Lab. Papers on Optical Glass, No. 7.)

The course of melting operations is followed from beginning to end and the essential features of procedure are described. Details of practice which are common to all forms of glass-making and are familiar to glass-makers in general are either omitted or passed over with brief descriptions, and attention is concentrated on those matters which in the making of optical glass differs from that of other kinds. Because of the fact that the purposes for which optical glass is to be used are in many respects radically different from those of other glasses, and require that exact optical and other physical properties be maintained and that certain defects be eliminated, it is essential that manufacturing operations be controlled throughout by methods of precision. The article describes the general course which must be followed to accomplish these results and the effects caused by departures from the standard of procedure, and takes up in more detail the principal defects which are likely to occur, and considers their causes and the methods of avoiding them. Some of the subjects discussed are: The effects of different available batch-materials upon melting operations and the range of choice in this matter; the necessity of close temperature regulation and the results of inattention to this; fining operations, especially with reference to the elimination of bubbles, and the causes and prevention of bubbles in general; variations of optical properties from requirements and to what they are due; differences of procedure required for the different types of glass; stirring operations, and the manner in which they should be conducted to obtain glasses relatively free from striæ.

C. N. F.

CHEMICAL TECHNOLOGY.—*An improved method of optical glass manufacture.* GEORGE W. MOREY. Journ. Amer. Ceram. Soc. **2**: 146–150. February, 1919. (Geophysical Lab. Papers on Optical Glass, No. 8.)

Stirring is begun during the fill and is continued during the fining period. Details are given of changes in procedure following this departure from the usual schedule. The results show that with proper furnace control, the customary time of manufacture of a pot of glass can be reduced to 24 hours, with improvement in color due to diminished pot corrosion.

G. W. M.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES.

BIOLOGICAL SOCIETY

601ST MEETING

The 601st regular meeting of the Biological Society of Washington was held in the Assembly Hall of the Cosmos Club on November 15, 1919; called to order at 8.10 p.m. by Vice-President VERNON BAILEY. Twenty-six persons present.

Under heading of brief notes Dr. L. O. HOWARD reported a letter read before the council from B. W. EVERMANN in which Dr. Evermann regretted that he was unable to attend the anniversary meeting on November 1.

Dr. R. W. SHUFELDT exhibited living young of the southern soft-shelled turtle [*Amyda ferox* (Schneider)] and gave an account of the distribution and habits of this group of turtles.

W. H. OSGOOD gave a brief synopsis of the meetings of the American Ornithologists' Union held during the past week in New York City.

A. WETMORE remarked upon the attitude of the male sage grouse [*Centrocercus urophasianus* (Bonaparte)] in strutting, as shown in motion pictures taken by W. L. FINLEY.

The regular program consisted of three communications:

N. HOLLISTER: *Relative abundance of waterfowl in Wisconsin* (illustrated by diagrams). This paper, based on observations made at Delavan Lake in southeastern Wisconsin, will be published in the *Auk*. The paper was discussed by W. H. OSGOOD, A. WETMORE and V. BAILEY.

A. WETMORE: *A peculiar habit of grebes* (with exhibition of specimens). This communication will appear in full in the *Condor*. The paper was discussed by R. W. SHUFELDT and V. BAILEY.

E. O. WOOTON: *Notes on a short visit to Tamaulipas*. Prof. Wooton gave an interesting account of a trip made during midsummer 1919 to examine the possibilities of Northern Tamaulipas in regard to agriculture and range. Although the time of year was unfavorable for botanical collecting, 207 species of plants were preserved and of these several proved to be new to science. A general account of the region and of its vegetation was given. The paper was discussed by E. A. GOLDMAN, V. BAILEY and A. WETMORE.

ALEXANDER WETMORE, *Recording Secretary pro tem.*

SCIENTIFIC NOTES AND NEWS

At a meeting held on November 25 in the main auditorium of the New National Museum, Professor IRVING FISHER, of Yale University, addressed the Scientific-Technical Section of the Federal Employees Union on the subject of "The purchasing power of salaries." The speaker elaborated his theory of a stabilized dollar, pointing out that an invariable unit of value is of even greater importance than invariable units of other quantities, such as length and mass. The Section voted to appoint a Committee for a study of the proposal for a more stable unit than the gold dollar, with instructions to report back a resolution granting or withholding endorsement according to the findings of the Committee.

Dr. P. G. AGNEW, physicist in the Electrical Division of the Bureau of Standards, has resigned to become secretary of the American Engineering Standards Committee, with headquarters at the Engineering Building, 29 West 39th Street, New York City.

Dr. LOUIS A. BAUER, director of the Department of Terrestrial Magnetism, Carnegie Institution of Washington, gave an illustrated lecture on "The solar eclipse of May 29, 1919, and the Einstein effect" before the Royal Astronomical Society of Canada at the University of Toronto on December 2, and at the College of the City of New York on December 4. On December 3 Dr. Bauer, assisted by Dr. S. J. MAUCHLY, gave a lecture on the magnetic and electric work of the Department before a special meeting of the Mathematical and Physical Society of the University of Toronto.

Mr. N. H. DARTON, geologist of the U. S. Geological Survey, will spend two months in the Dominican Republic early in 1920 to investigate oil conditions for a New York company.

Dr. W. S. GORTON has resigned from the Bureau of Standards, where he has been engaged in work on potential-transformer testing and automotive engine ignition, to accept a research position with the Western Electric Company in New York City.

Dr. CARL P. HARTLEY, pathologist in the office of Forest Pathology, Bureau of Plant Industry, resigned in October to accept a position as pathologist with the Instituut voor Plantenziekten en Cultures, Buitenzorg, Java.

Mr. W. B. HEROY, formerly of the U. S. Geological Survey, and recently on the staff of the McGraw-Hill Company, publishers of technical periodicals, has resigned to accept a position as geologist with the Sinclair Consolidated Oil Corporation, with offices at 120 Broadway, New York City.

Messrs. F. L. HESS and R. M. OVERBECK, of the U. S. Geological Survey, are on a six months' leave of absence and are engaged in exploration of deposits of ores of the rare metals in Bolivia, for private interests.

Miss MARTINEAU KNIGHT, geologic aid of the U. S. Geological Survey, has been employed by the Roxana Oil Company of California as office geologist.

Dr. S. KONISKI of the Department of Commerce and Agriculture of Japan, and Technical Adviser to the Japanese delegates at the Peace Conference, visited Washington in December.

Prof. T. H. LABY of the University of Melbourne visited the scientific laboratories of Washington in December, while on his way back to Australia from England, where he has been doing research work on war problems.

Mr. A. G. MADDREN resigned from the U. S. Geological Survey in December, to enter the employ of the Vulcan Oil Company. He will make a detailed study of part of the Ranger oil field, Texas, under the direction of RALPH ARNOLD.

Senator MEDILL MCCORMICK of Illinois has been appointed a regent of the Smithsonian Institution.

Mr. JOHN D. MCCHESNEY, disbursing clerk of the U. S. Geological Survey since its organization, died on December 5, 1919.

Mr. C. C. OSBON, statistical clerk in charge of peat and asphalt in the mineral resources branch of the Geological Survey, has resigned to do statistical work for the Marland Refining Company.

Prof. LOUIS VALENTINE PIRSSON, professor of geology at Yale University, and a non-resident member of the ACADEMY, died on December 8, 1919, in his sixtieth year. Professor Pirsson was born in New York City, November 3, 1860. His entire academic career of thirty-seven years was spent at Yale. His work was principally in petrology, particularly of the igneous rocks of Montana and New England. He had been a member of the ACADEMY since 1900, and was also a member of the Geological Society of Washington.

Mr. HENRY S. RAWDON, physicist in the metallurgical division of the Bureau of Standards, went to Europe in November, to spend about three months in collecting information on permissible limits for sulfur and phosphorus in steels.

A wireless message from South America states that Dr. GAILLARD SHERBURNE ROGERS, geologist of the U. S. Geological Survey, was drowned on November 18, 1919. He was engaged at the time in the examination of oil and gas concessions in Colombia. Dr. Rogers was born on March 21, 1889, in New York City. He joined the Geological Survey in 1911 and had devoted his attention particularly to the geology of oil and gas deposits. He was a member of the ACADEMY and of the Geological Society.